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DEPARTMENT OF BOTANY, MASSACHUSETTS STATE COLLEGE
FARLOW HERBARIUM OF CRYPTOGAMIC BOTANY,
HARVARD UNIVERSITY

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CONTRIBUTION FROM THE LABORATORIES OF CRYPTOGAMIC BOTANY AND THE FARLOW HERBARIUM, HARVARD UNIVERSITY.—NO. 196

# NOTES ON NEW ENGLAND ALGAE

## II. SOME INTERESTING NEW HAMPSHIRE ALGAE

ROY M. WHELDEN

That the many and varied bodies of fresh water of New Hampshire should yield rich collections of algae may be anticipated from the frequency with which early American algologists described such plants. Often however the abundance of species and forms encountered in a single pond far surpasses one's expectations, especially when the examination is exhaustively thorough. Among ponds yielding rich returns, Downing Pond in the town of New Durham offers much of particular interest to a student of the algae. Formed at least in part by the damming of a river, raising the water level several feet, this pond covers an area of perhaps 200 acres, over the greater part of which the depth of water is not more than 10 feet. The sandy bottom of the shallower portions, overlaid with a thin layer of fine ooze, is covered with an abundance of *Potamogeton*, *Vallisneria*, *Brasenia*, *Castalia* and other plants, among which occurs an abundance of *Utricularia*. In the deeper portions there are many specimens of *Nitella flexilis* growing on a coarse gravel bottom.

Throughout the summer months all this submerged vegetation, as well as such twigs and logs as occur, are commonly thickly covered with an ooze of algae. The water itself is rich in plankton

material, which is not considered in this paper. Many of the algae persist undiminished in numbers until late in the fall and even the coldest weather of the winter does not cause all of them to disappear.

While extensive observations have been made throughout several years, the observations herein reported are based on material gathered and examined in August, then preserved by formalin and studied exhaustively as opportunity offered. They comprise considerations of several algae which differ notably from previously known material from this region or whose occurrence has been rarely cited.

## THE GENUS STAURASTRUM

Desmids were very well represented in all collections made from this pond, the various genera being proportionately equally well represented. About 30 species of Staurastrum were found in large numbers, most of them being species of larger than average size for the genus. Among these, one of the most frequently encountered in all material was *Staurastrum Arctiscon* (Ehrenb.) Lund., and occurring even more abundantly than the species was the variety *truncatum* Irénée-Marie. (FIG. 4.) In the hundreds of specimens examined some slight variations were noted: by far the greater number of them were noticeably larger than those described by Irénée, the length (processes excluded) ranging from 90–122 μ (processes included, from 155–196 μ); the breadth (processes excluded) was 60–75 μ (processes included, the breadth was 133–162 μ); the breadth of the isthmus 30–42 μ. The other most noticeable variation was found in the nature of the ends of the bifurcated processes. Irénée characterizes the variety in part by the lack of spines ("pointes") at the ends of the processes. In the New Hampshire material this is equally characteristic of a great many of the specimens, but not all. Many have three well-developed acute spines 2–3 μ long at the apex of each arm of the process. The relative dimensions of the cell body and the length and amount of divergence of the processes also show considerable variation.

This variety is not infrequently encountered in other parts of New Hampshire, as well as in western Maine; but in no other station have I found it so plentiful as in the present one.

*Staurastrum longispinum* (Bail.) Arch. was another species found in some abundance. Among the specimens were some which differed from the type in having three equally large spines (30 μ long) in a vertical row at one, two or all three angles of a semicell. No specimens were observed in which all the angles of the cell were so armed.

## The Genus Micrasterias

The genus Micrasterias is conspicuously present in nearly all collections from this pond, with *M. foliacea* Bailey the most abundant in numbers, and in filaments often nearly a millimeter long, but rather fragile and easily broken. Fifteen species have appeared in the various gatherings, most of them rather abundantly. Among the rarer ones is *M. Johnsonii* W. & G. S. West.

In 1897 the Wests described this species of *Micrasterias* from Florida. It is characterized by very deep incisions, by the occurrence of two very long spines terminating each division of the lateral lobes, by having one long straight spine from each angle of the polar lobes and by the presence of a row of very fine spines within the margins of the several lobes. The dimensions of the species were given as 270 μ long, 275 μ broad, with the apical lobe 26 μ and an isthmus 30 μ broad.

Taylor (1935) described a variety *bipapillata* from Newfoundland. This variety has shorter spines terminating the lateral lobes, is quite devoid of intramarginal spines and has two mammilate-subaculeate projections on each side of the apical margin of the polar lobe. The variety is somewhat smaller than the species, the length being 250 μ and breadth 240 μ.

Salisbury (1936) described from Florida, as *Micrasterias ranoides*, an alga quite similar to the species, but lacking intramarginal spines and having the polar lobe about one half the width of the cell. The dimensions were: length 208–269 μ; breadth 202–254 μ; thickness 45–50 μ, apex 102–108 μ and isthmus 21–23 μ broad. Krieger (1939) reduced this to variety *ranoides* of *M. Johnsonii*.

To these there must now be added another variety which has much in common with the two above. Like them the surface of the cell lacks completely any ornamentation of intramarginal spines. Unlike them, each lateral lobe ends in two fairly stout

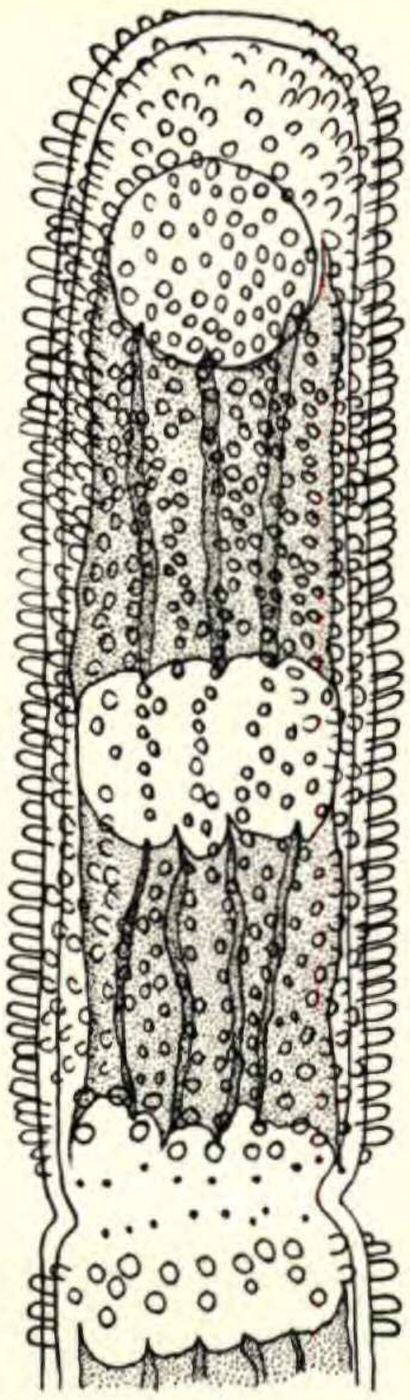
and usually rather blunt spines that are 17–25 μ long and strongly diverging. The polar lobe is broadly obcuneate, widening rapidly in its distal third to a breadth of 90–115 μ. The apical margin of this lobe is usually quite deeply indented in the middle. The exterior angle of the polar lobe ends in a long coarse spine; near this, on the apical margin there is a second spine which may be equal in size to that of the regular spine, but is often much smaller and may be completely missing in one or both the angles of one or both polar lobes. In some specimens the surface of the spines and even of the adjacent part of the lobe is gently and irregularly undulate. (FIG. 5a).

In size this variety varies somewhat, but is generally somewhat larger than any of the previously named forms. I describe this as:

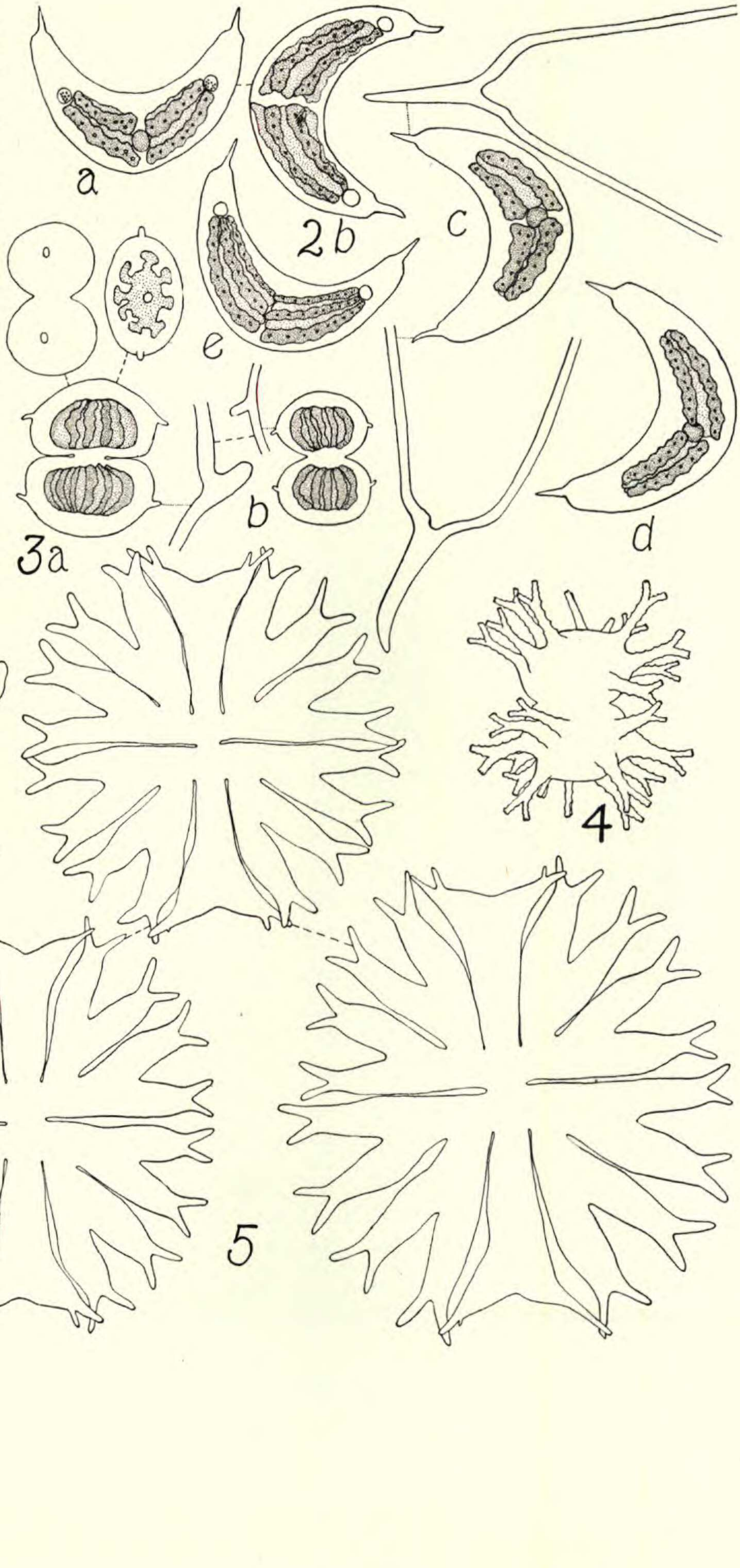
MICRASTERIAS JOHNSONII, var. **novae-angliae,** var. nov. FIG. 5. Differt a typo membrana sine spinis, et apicibus lob. polaris spinis uno vel duobus acutis armatis. Cellulis 280–348 μ long., 270–323 μ lat.; isthmo 19–30 μ lat., lob. polaribus 93–116 μ lat.

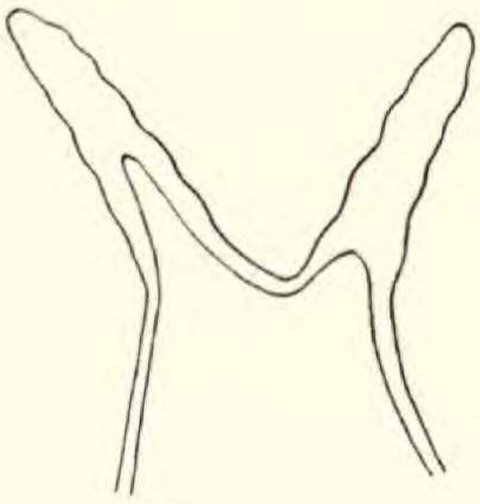
## THE GENUS COSMARIUM

Considering the large number of described species of *Cosmarium*, the genus appears to be very poorly represented in this pond, only two dozen species having so far been found in any quantity. Of these, *C. ovale* Ralfs, C. *Eloiseanum* Wolle, C. *Quinarium* Lund. & C. *margaritatum* (Lund.) Roy and Biss. are most frequent. Equally abundant and rather more interesting are the frequently encountered specimens of *Cosmarium contractum* var. *papillatum* W. & G. S. West. In the New Hampshire specimens however the cells, while very variable in size, have all much larger dimensions than given by others, having cell length 90–123 μ, cell breadth (without papillae) 62–96 μ; cell thickness 48–55 μ; breadth of isthmus, 19.5–26 μ; length of papillae 2–8 μ. Cell dimensions given by others are: length 73 μ; breadth 51 μ; thickness 44 μ, breadth of isthmus 20 μ, length of papillae 2–3 μ. (FIG. 3, a & b).



1



5a



4



5

## The Genus Spinoclosterium

*Spinoclosterium curvatum Bernard.* [*Closterioides spinosus Prescott.*]

In 1909 Charles Bernard described an alga collected in large ponds in the botanic garden at Singapore. He placed it in the new genus *Spinoclosterium*, close to *Closterium*, but readily distinguished from the latter by the presence of a single large spine terminating each apex of the cell. In all other details the plant is like *Closterium*, having a smooth wall, distinct large vacuoles containing several granules each, and a single large chloroplastid in each semi-cell. The plastid seemed to have six radiating bands, with many pyrenoids apparently serially distributed in the bands. His species, designated *curvatum*, measured 120–144 μ between apices, 150–170 μ along the concave, and 240–275 μ along the convex side. It was 47–52 μ broad, with apical spines 15–24 μ long and 5–7 μ broad at base. The spines were quite noticeably curved.

In 1937 Prescott, presumably unaware of Bernard's paper, recorded as *Closterioides spinosus* certain Closterium-like algae from Michigan. His species was distinguished by a smooth colorless cell wall, cells slightly attenuated to broadly rounded poles, each of which bears a single stout spine. There are two plastids per cell, each with 2–3 longitudinal regions showing pyrenoids in 3 or 4 irregular series; the cells measured 140–148 μ between apices, were 58–62 μ broad, and had spines 4.5 11.5 μ long. Subsequently Prescott, (1940) having seen living cells, considered them sufficiently distinct to warrant separation from *Closterium*, and very close to Bernard's *Spinoclosterium curvatum*. Since his plants are slightly stouter, bear stouter and longer spines, and have a distinct swelling of the apices, he separates them as *Spinoclosterium curvatum* var. *spinosum*. It is quite probable that this alga is not quite so rare as the infrequency with which it has been observed would suggest. I have seen many specimens collected from a marshy pond in Maine. There many of them were infected with a small fungus which had completely destroyed all normal cell content: those which escaped infection were so densely packed with food reserves as to obscure quite thoroughly the plastid structure. In the New Hampshire col-

lections on which this report is based *Spinoclosterium* cells are not truly rare. However it is evident that they occur either singly or at most in small groups of two or three individuals and so may be easily overlooked unless systematic search is made. Then they turn up frequently.

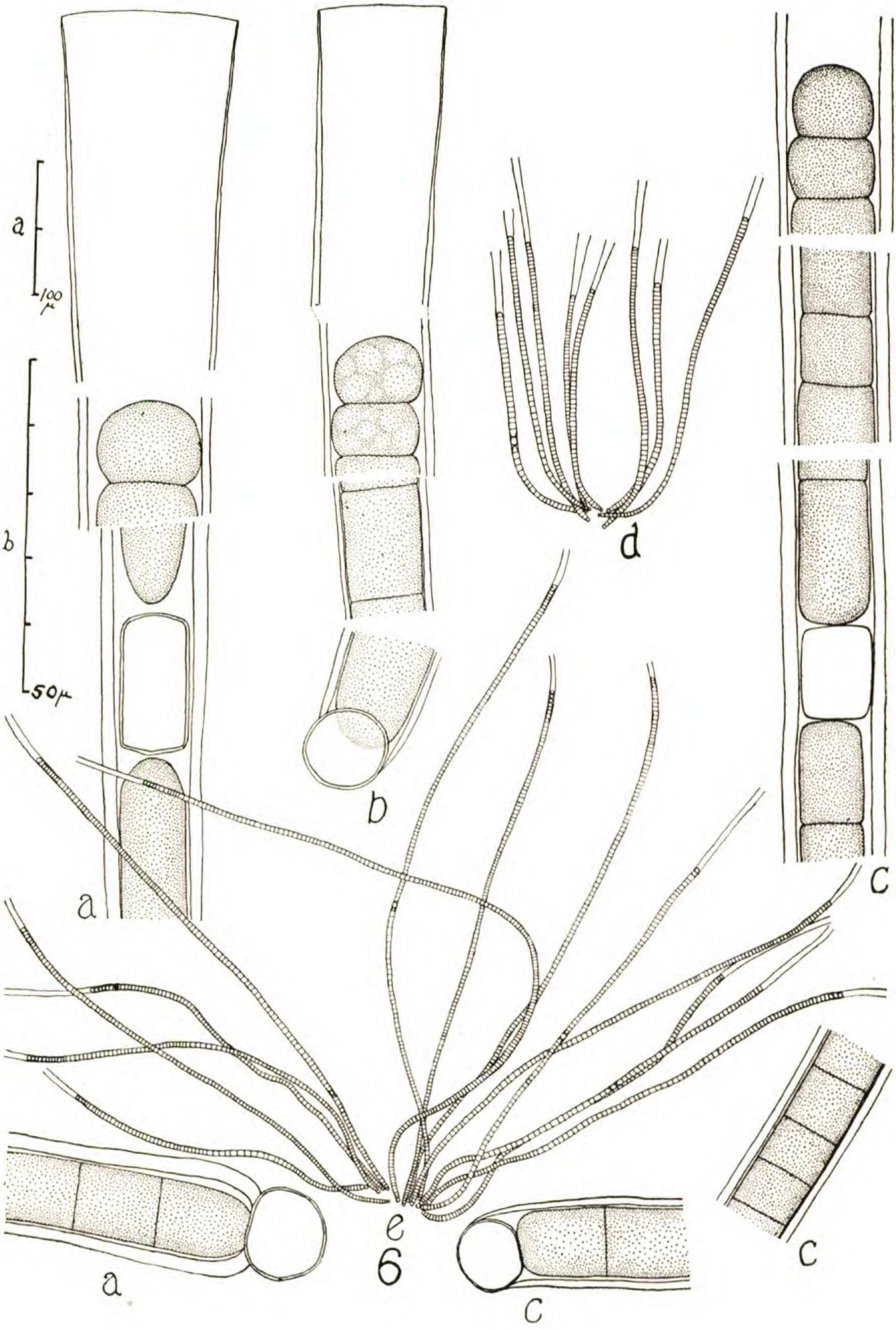
All those seen have been very strongly curved, the outer margin much more so than the inner. Tapering is very gradual from the center of the cell to a point a few microns from the apex, at which point a very abrupt narrowing occurs, culminating at the base of the spine. In some specimens there is a slight bulging of the outer margin of the cell just before this contraction point, causing the cell to appear distinctly swollen at this point (Fig. 2a). This swelling may appear only at one end of a cell, or at both, and is frequently entirely lacking. The strong spine which terminates the cell end is usually quite straight (Figs. 2a, d, e) although specimens having one (Fig. 2c) or both spines (Fig. 2b) quite distinctly curved outward are not rare.

The chloroplastids are composed of five longitudinal plates each having a row of 6–10 pyrenoids. A large vacuole is present at each end of the cell, but in only a few of my specimens (all from preserved material) was there any indication of granules within the vacuole. In these there were 10–14 small granules present.

All specimens were quite uniform in size, measuring 144–160 μ between the apices of the spines, 54–61 μ in diameter at the broadest part and having spines 17–20 μ long. Fig. 2.

## The Genus Penium

Specimens of the genus *Penium* are not common in this station: *P. spirostriolatum* Barker and *P. margaritaceum* (Ehrenb.) Bréb. are found infrequently, and *P. rufescens* Cleve rarely. One which occurs quite rarely seems best considered a variety of *P. margaritaceum*, characterized by the presence of many papillae over the entire surface of the cell excepting a narrow band at the isthmus, and the central portion of the apical surface. These papillae are 2–3.5 μ long, and arranged either irregularly or less frequently in vaguely delineated longitudinal rows. I designate these plants as:


a
100 μ
b
50μ
a
b
d
c
a
e
6
c
c

PENIUM MARGARITACEUM (Ehrenb.) Bréb. var. **papilliferum,** var. nov. Penium membrana papillifera, papillis irregulariter dispersis vel lineis ordinatis; cell. 150 μ long.; Papillis 2–3.5 μ longit. FIG. 1.

## MICROCHAETE VS. LEPTOBASIS

The blue-green algae are found in wide variety in this pond, but usually only in rather small numbers. Periodically exceptions occur, some form becoming extremely abundant for a short time, as occurs during the last two or three weeks of August, or early September, when *Nostoc planctonicum* becomes a dominant and conspicuous plant in the upper 2–3 feet of water.

Among those species which appear to occur regularly but never in any quantity is a species of *Microchaete* which seems worthy of some comment. All specimens that were observed were growing on the submerged stems or leaf sheaths of various phanenogams; the lower part of the filament of the *Microchaete* being usually, but not invariably, close pressed thereto. They are found in small groups composed of 3–16 filaments, the free ends of which may stand erect and nearly parallel, (FIG. 6d) or may spread in a group of widely divergent strands, (FIG. 6e) mostly 300–600 μ long, but infrequently reaching more than 1 mm. Each trichome is surrounded by a firm colorless sheath 1.3–2.0 μ thick in its thickest part. As a rule the sheaths are unstratified, but several groups of filaments were observed in which all or nearly all of the sheaths were composed of two or three very distinct strata which faded out only towards the apex of the filament, where the sheaths became very much thinner. One of the most noticeable characteristics of the sheaths was in their dimensions. The greater number of them showed a very evident increase in diameter from the base upwards: (FIG. 6a) measurements taken at 100 μ intervals of one filament are as follows—11.5, 13, 15, 15, 17, 17, 17, 17.5, 18, 19, 22 μ. Other filaments, often in the same group as those with increasing diameters, are either isodiametric (FIG. 6c), or else may even show a slight decrease as in one case from 16.5 to 15 μ.

The trichomes likewise show considerable variation, both in dimensions and in the nature of the component cells. In the filament whose increasing dimensions are given above the corresponding dimensions of the trichome increase from a basal

9.5 μ to a maximum of 12.5 at the apex of the trichome, which ended nearly 300 μ below the end of the sheath. The dimensions of the trichome in the other sheath mentioned above decreased from 12.5 to 11.5 μ. The smallest trichome diameter measured was 7 μ, in a sheath 11 μ in diameter: this same filament was 15 μ broad at the apex, with the trichome 11.5 μ at its apex. The shape of the cells composing the trichomes varied from base to apex. The cells of the basal portion were rectangular in optical section and varied in length from 0.6–1.6 times as long as broad: in this portion of the plant there was none or only a very slight constriction of the trichome at the dissepiments. These relative dimensions might obtain nearly throughout the trichome, but in many cases the cells of the central portion were conspicuously longer, being up to 2 times as long as broad, and seldom less than 1.2 times as long: here constrictions were rarely evident. Near the apex of the trichome the cells were much shorter, 0.6–0.9 times as long as broad, and so obviously constricted that they occasionally appeared like beads (FIGS. 6a, b, c). The cell contents are usually very uniformly homogeneous. In many cases however the apical cells of the filament were prominently vesiculate (FIG. 6b). In a few instances, filaments were seen in which the cells contained many small vacuoles, possibly a consequence of the condition of those cells at the time of preservation.

Heterocysts were both basal and intercalary. The basal heterocysts were mostly subspherical and 9.5 to 12.5 μ in diameter (FIG. 6a, b, c); a few were somewhat flattened, being 11–13 μ broad and 7.5–9 μ long. Intercalary heterocysts were cylindrical and 9–21 μ long (FIG. 6, a, c). No other types of cells were observed, nor was any sign of branching noted.

The identification of this plant offered certain problems. *Microchaete* comprises those algae in which a single trichome, rarely branched, is included in a distinct sheath usually homogeneous but in a few species distinctly stratified, the sheath either of uniform diameter throughout or slightly narrowed towards the apex. The filaments grow attached to various substrates, either singly or in small groups. Basal and less frequently intercalary heterocysts occur, as well as akinetes. With the genera *Aulosira* and *Hormothamnion*, *Microchaete* makes up the family Microchaetaceae.

Elenkin (1915) described the genus *Leptobasis*, the only genus in the family Leptobasaceae, characterized principally by the distinct widening of the filament towards the apex. There is also usually a distinct narrowing of the filament in the basal portion, but the greater part of the filament is of uniform diameter. Basal and rarely intercalary heterocysts occur. The separation of this family from the Microchaetaceae seems often to be a matter of some doubt. In *Leptobasis* there is one species *L. crassa* (G. S. West) Geitler, originally described by G. S. West as *Microchaete crassa*. This plant, occurring at 2600 m. in the Eastern Andes mountains, had filaments 13–16 μ broad, slightly narrowed at the base and not widened upwards, colorless unstratified sheaths, and grew in small groups of slightly bent filaments. The basal cells of the trichome were rather longer than broad, 9–10.5 μ in diameter, whereas those near the apex were 12–13 μ in diameter and rather shorter than broad. There were no constrictions at the cross walls. The spherical heterocysts were mostly basal and 9–10.5 μ in diameter. Certainly there was little which justified removing the species from *Microchaete* to a position in *Leptobasis*. Two species of *Microchaete* need now be considered. These are *M. uberrima* N. Carter, found in rice fields of India, and *M. calothrichoides* Hansgirg, in standing water in Prater in Vienna. Miss Carter's species is characterized by its filaments of uniform diameter 16–18 μ throughout, with firm brown sheath around a trichome 10–14 μ in diameter. She also describes a form *minor* with filaments 9–11 μ broad and trichomes 6.5–8 μ. This at once suggests that there may be considerable variation in size in species of this genus. *M. calothrichoides* has filaments 10–16 μ (–20 μ) broad, occurring singly or in small groups, the latter forming a dull gray-green layer of straight or bent strands. The sheaths are thick, stratified, often more or less encrusted, and colorless. Cells at the base of the filament are 6–8 μ broad and ⅓–1 times as long, with distinct constrictions at the cross-walls. The basal heterocysts are egg-shaped to elongate—ellipsoidal, 6–8 μ broad.

No other of the described species seems to approach in character the New Hampshire plant. In size it could well be placed in either species, though it tends to be distinctly larger than *M. calothrichoides:* the shape of the cells and the size and shape of

the basal heterocysts equally serve to distinguish it from this species. The most conspicuous distinction between it and *Leptobasis crassa* is found in the distinctly constricted filaments of the former. The slightly larger average dimensions of the filament and equally slightly smaller dimensions of the trichome are not sufficient to set it off. It therefore seems justifiable to identify it as *Microchaete crassa* G. S. West (= *Leptobasis crassa* (G. S. West) Geitler), while noting specifically the fact that there is a distinct increase in the diameter from base to apex in the majority of the filaments. The great variability in the form of the filaments in this species throws doubt on the basis on which *Leptobasis* is established; it is better to place its species in the genus *Microchaete*, where they may be distinguished as a subgenus. Following DeToni (Noterelle di nomenclatura algologica VIII. Terzo elenco di Missoficee omonime. 1936) this alga should be *Fremyella crassa* (G. S. West) DeToni.

## DESCRIPTION OF FIGURES

FIG. 1 and details of FIGS. 2, 3, 5 and 6 are all drawn to scale b; All others are drawn to scale a.

1. PENIUM MARGARITACEUM (Ehrenb.) Bréb. var. PAPILLIFERUM, var. nov.
2. SPINOCLOSTERIUM CURVATUM Bernard. *A*, *d* and *e* are specimens with straight spines; *b*, with both spines curved; *c*, with one curved and one straight spine.
3. COSMARIUM CONTRACTUM var. PAPILLATUM W. & G. S. West. *a* is a large form, *b* a small one.
4. STAURASTRUM ARCTISCON var. TRUNCATUM Irénée-Marie.
5. MICRASTERIAS JOHNSONII W. & G. S. West var. NOVAE-ANGLIAE, var. nov., showing variations in size and in nature of spines of apical lobe. (*5a*) Portion of apex of lateral lobe.
6. MICROCHAETE CRASSA G. S. West. Habit. *a*. Portions of a filament showing considerable increase in size base to apex. *b*. Portions of a filament showing slight increase, and with cells showing vesiculate cytoplasm. *c*. Portions of filament in which diameter is nearly uniform. *d*. A small group of nearly erect filaments. *e*. A larger group of filaments, widely diverging.

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# POLLINATION OF THE ERICACEAE: VI. VACCINIUM CAESPITOSUM ON MT. KATAHDIN[1]

Harvey B. Lovell

The long awns and slender anther-tubes together with the method of nectar secretion make *Vaccinium caespitosum* Michx. one of the most specialized flowers in the Heath Family. Although the related species, *V. uliginosum*, has been studied in Europe, there do not appear to be any published observations on the anthesis and insect visitors of the present species. *V. caespitosum* grows abundantly on the higher slopes of Mt. Katahdin above the tree line, where in spite of the inclement weather it sets fruit abundantly. Each leafy shoot produces a single nodding flower at the first node and the remaining leaves of the shoot almost completely conceal the flower from above. On steep slopes the side of the corolla exposed to the light is pink, whereas that next to the hillside remains white.

The five-merous flowers have a slender corolla-tube 5 to 5.5 mm. long which tapers down to 1.5 mm. in diameter at the apex. Since the stigma partially closes this opening, the nectar is rendered inaccessible to all but long-tongued insects. The corolla is very firm and tough. The capitate stigma, which stands just inside of the mouth of the flower, is very glutinous and pollen clings to it readily. Around the base of the style there is a thick, green ring, evidently the nectary, although in most cases little nectar was found on it (Fig. 1, A, E), a lack which will be discussed later. Inserted on the margin of the nectary and base of the corolla are the ten stamens. In many flowers the corolla fell off leaving the stamens still attached to the

[1] Contribution from the Biology Department, University of Louisville.